

WHAT IS CLAIMED IS:

1. A lithographic projection apparatus, comprising:
  - an illuminator configured to provide a projection beam of radiation;
  - a support configured to support a patterning device, the patterning device configured to pattern the projection beam according to a desired pattern;
  - a substrate table configured to hold a substrate;
  - a projection system configured to project the patterned beam onto a target portion of the substrate; and
  - a reflector alignment system configured to direct an alignment beam of radiation through the projection system to measure apparent relative positions of a first reference mark provided in a fixed position on a patterning device side of the projection system and a second reference mark provided in a fixed position on a substrate side of the projection system.
2. An apparatus according to claim 1, wherein a first numeric aperture of the reflector alignment system is smaller than a second numeric aperture of the projection system.
3. An apparatus according to claim 1, wherein the first and second reference marks comprise gratings.
4. An apparatus according to claim 1, wherein one of the first and second reference marks comprises a running fringe pattern formed by interference between two beams intersecting at an angle.
5. An apparatus according to claim 1, wherein the first and second reference marks are provided in planes congruent with object and image planes of the projection system.
6. An apparatus according to claim 1, further comprising a controller, responsive to the reflector alignment system, configured to control a position of at least one of the patterning device and the substrate to compensate for or alleviate errors detected by the reflector alignment system.

7. An apparatus according to claim 1, further comprising a second reflector alignment system for directing a second alignment beam of radiation through the projection system to measure apparent relative positions of a third reference mark provided in a fixed position on the patterning device side of the projection system and a fourth reference mark provided in a fixed position on the substrate side of the projection system, the second alignment beam propagating through the projection system along a different optical path than the alignment beam.

8. A device manufacturing method, comprising:

projecting a patterned beam of radiation onto a target portion of a layer of radiation-sensitive material at least partially covering a substrate using a projection system comprising a plurality of reflectors; and

detecting positional errors or disturbances of the reflectors in the projection system by directing an alignment beam through the projection system to measure apparent relative positions of first and second reference marks provided respectively at a patterning device side and a substrate side of the projection system.

9. A method according to claim 8, further comprising forming one of the first and second reference marks by running a fringe pattern formed by interference between two beams intersecting at an angle.

10. A method according to claim 8, further comprising providing the first and second reference marks in planes congruent with object and image planes of the projection system.

11. A method according to claim 8, further comprising controlling, responsive to the measured apparent relative positions, a position of at least one of the patterning device and the substrate to compensate for or alleviate errors detected by the reflector alignment system.

12. A method according to claim 8, wherein detecting positional errors or disturbances further comprises directing a second alignment beam of radiation through the projection

system to measure apparent relative positions of third and fourth reference marks provided respectively at the patterning device side and the substrate side of the projection system, the second alignment beam propagating through the projection system along a different optical path than the alignment beam.

13. A lithographic projection apparatus, comprising:
  - illuminating means for providing a projection beam of radiation;
  - supporting means for holding a patterning means, the patterning means for patterning the projection beam according to a desired pattern;
  - substrate holding means for holding a substrate;
  - projecting means for projecting the patterned beam onto a target portion of the substrate; and
  - reflector aligning means for directing an alignment beam of radiation through the projection system to measure apparent relative positions of a first reference mark provided in a fixed position on a patterning means side of the projecting means and a second reference mark provided in a fixed position on a substrate side of the projecting means.
14. An apparatus according to claim 13, wherein a first numeric aperture of the reflector aligning means is smaller than a second numeric aperture of the projecting means.
15. An apparatus according to claim 13, wherein the first and second reference marks comprise gratings.
16. An apparatus according to claim 13, wherein one of the first and second reference marks comprises a running fringe pattern formed by interference between two beams intersecting at an angle.
17. An apparatus according to claim 13, wherein the first and second reference marks are provided in planes congruent with object and image planes of the projecting means.
18. An apparatus according to claim 13, further comprising controlling means, responsive to the reflector aligning means, for controlling a position of at least one of the

patterning means and the substrate to compensate for or alleviate errors detected by the reflector aligning means.

19. An apparatus according to claim 13, further comprising a second reflector aligning means for directing a second alignment beam of radiation through the projecting means to measure apparent relative positions of a third reference mark provided in a fixed position on the patterning means side of the projecting means and a fourth reference mark provided in a fixed position on the substrate side of the projecting means, the second alignment beam propagating through the projecting means along a different optical path than the alignment beam.